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Ueda

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(54) **REFLECTION FRAME-EQUIPPED SHEET**

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(51) **Int. Cl.**

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G06F 3/042	(2006.01)
G03B 21/58	(2014.01)
B43L 1/04	(2006.01)
B43L 1/00	(2006.01)

(52) **U.S. Cl.**

CPC ... ***B43L 1/08*** (2013.01); ***B43L 1/04*** (2013.01); ***G06F 3/0428*** (2013.01); ***B43L 1/00*** (2013.01); ***B43L 1/004*** (2013.01); ***G03B 21/58*** (2013.01)

(58) **Field of Classification Search**

CPC B43L 1/08; B43L 1/04; B43L 1/00; B43L 1/004; G06F 3/0428; G03B 21/58

USPC 359/443, 461; 353/65

See application file for complete search history.

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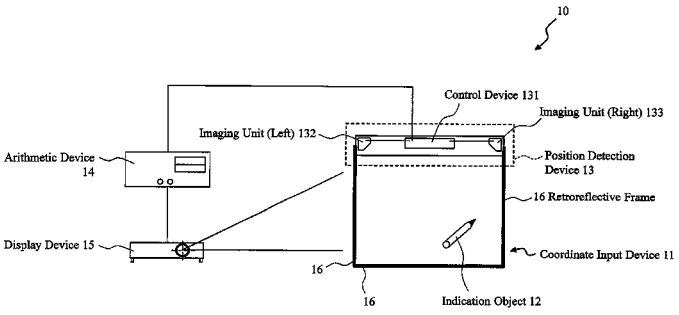
(74) *Attorney, Agent, or Firm* — Mattingly & Malur, PC

(57) **ABSTRACT**

An interactive whiteboard system that can be put on a desk or a floor surface is implemented. A reflection frame-equipped sheet in accordance with the present invention has a flexible sheet, and a retroreflective frame(s) that is/are fixed to given one side or given two opposite sides of the sheet.

8 Claims, 14 Drawing Sheets



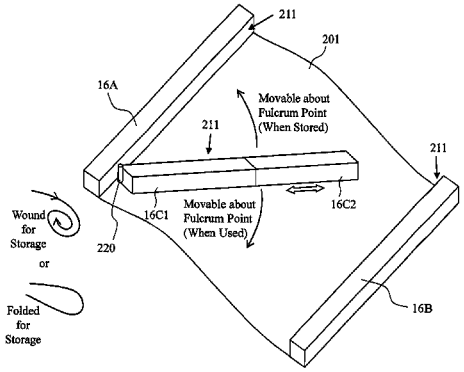


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Fig. 1

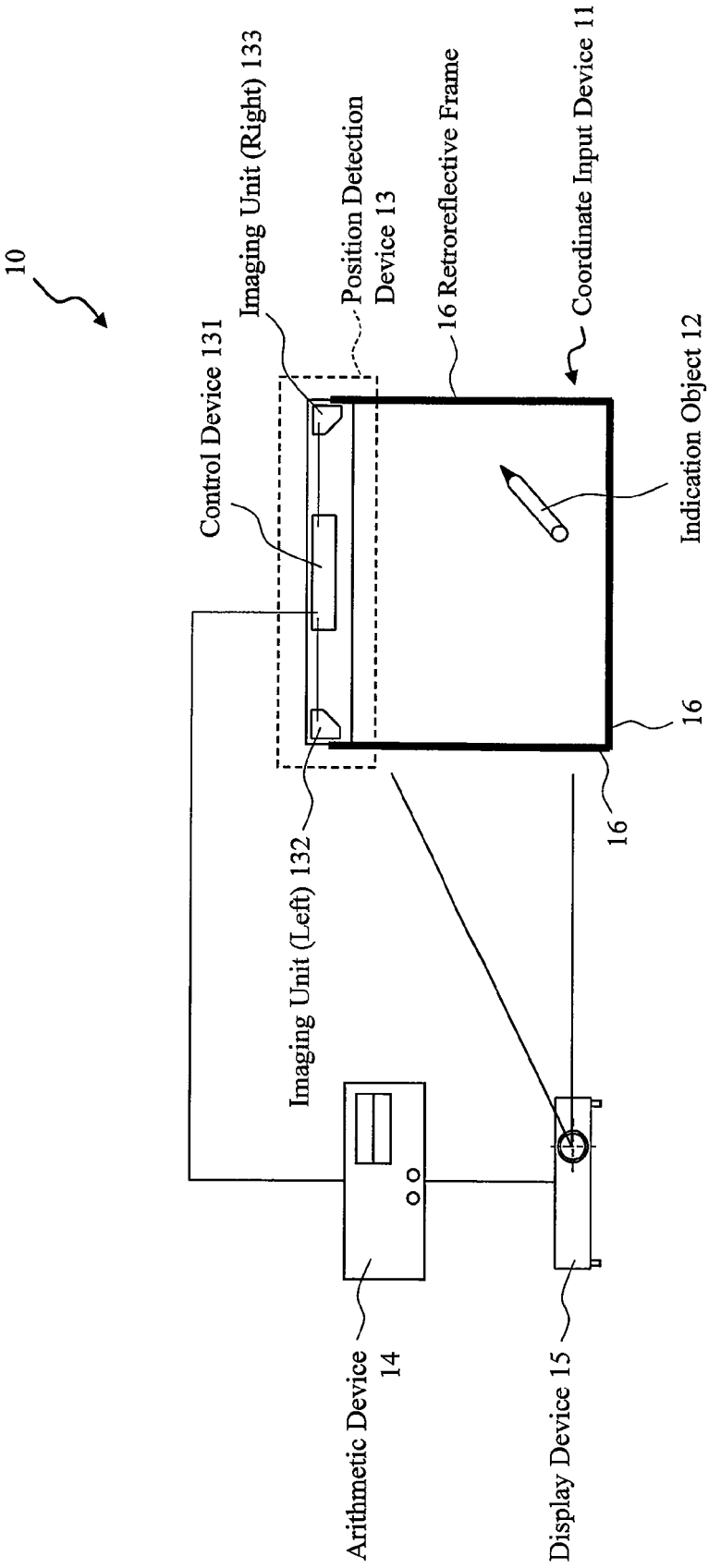

10
Imaging Unit (Right) 133
Position Detection Device 13
16 Retroreflective Frame
Coordinate Input Device 11
Control Device 131
Indication Object 12
16
16
Imaging Unit (Left) 132
Arithmetic Device 14
Display Device 15

Fig. 2

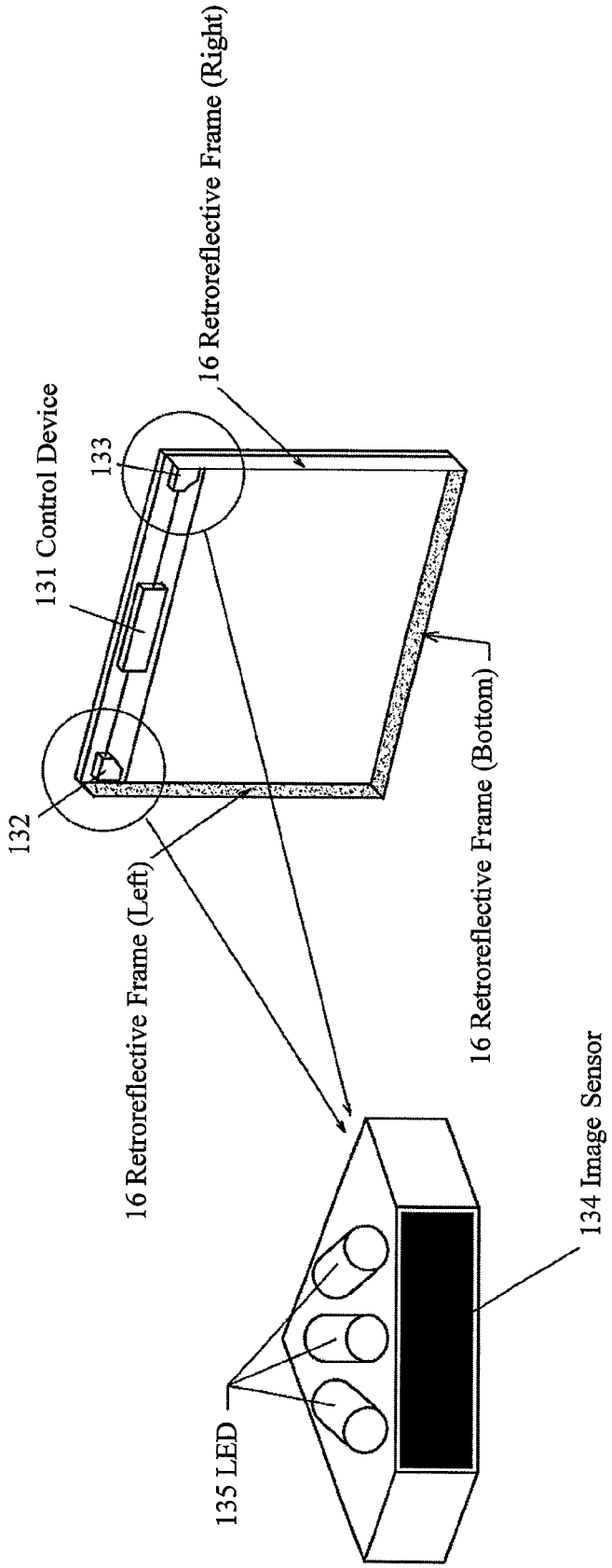
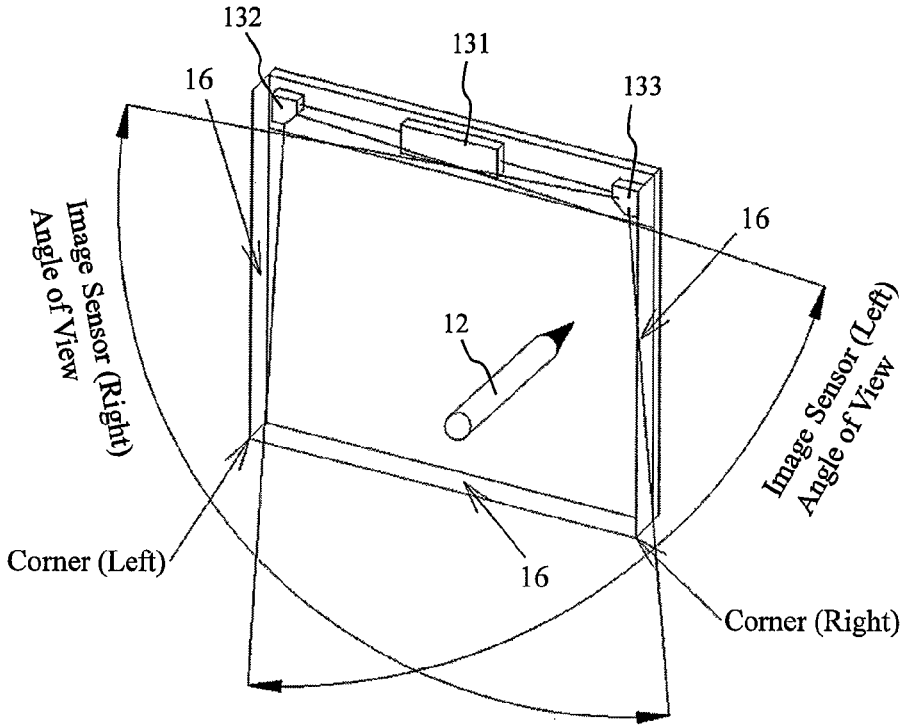

16 Retroreflective Frame (Right)
133
131 Control Device
132
16 Retroreflective Frame (Left)
16 Retroreflective Frame (Bottom)
134 Image Sensor
135 LED

Fig. 3


132
131
133
16
16
12
Image Sensor (Right) Angle of View
Image Sensor (Left) Angle of View
Corner (Left)
16
Corner (Right)

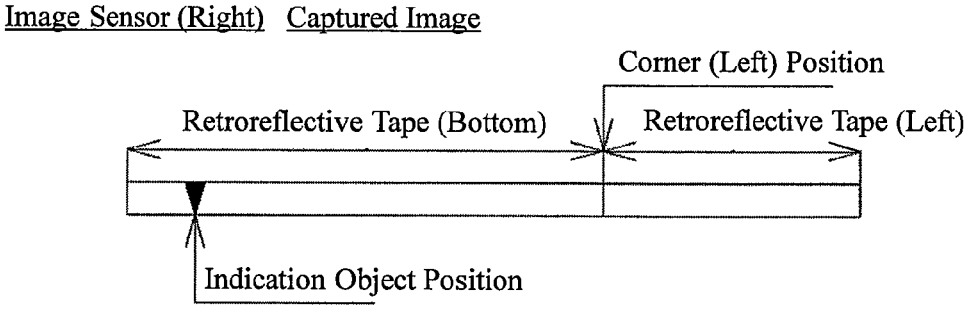


Image Sensor (Right) Captured Image
Corner (Left) Position
Retroreflective Tape (Bottom)
Retroreflective Tape (Left)
Indication Object Position

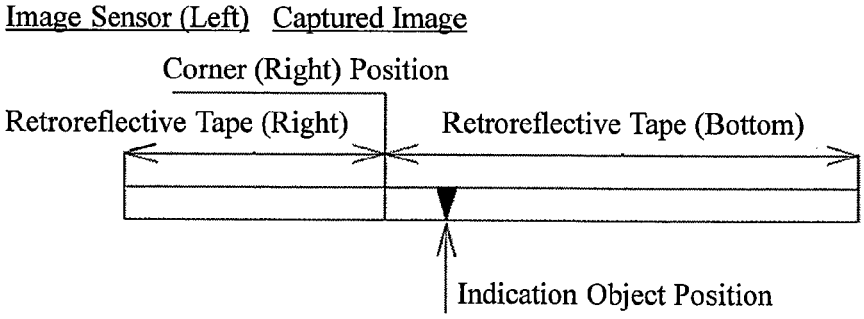


Image Sensor (Left) Captured Image
Corner (Right) Position
Retroreflective Tape (Right)
Retroreflective Tape (Bottom)
Indication Object Position

Fig. 4

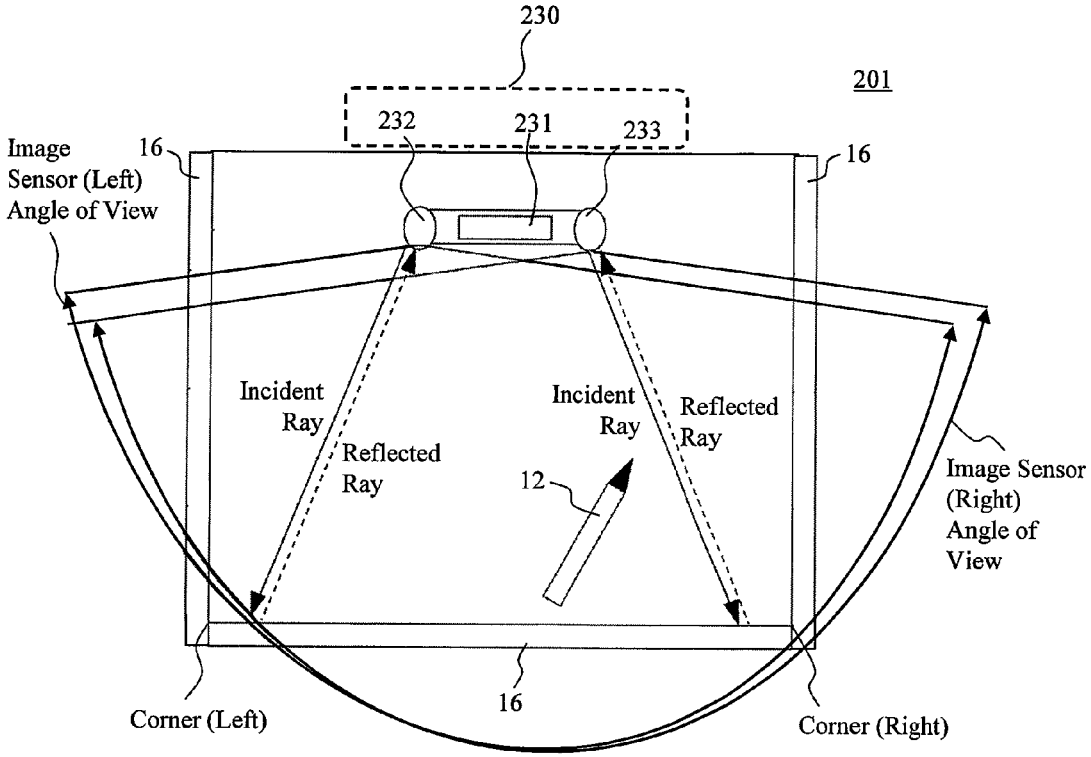


Image Sensor (Right) Captured Image

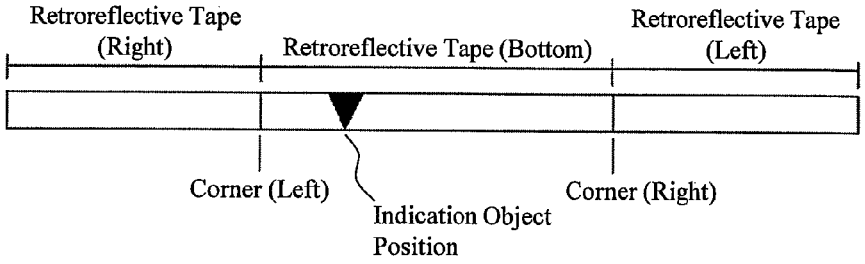


Image Sensor (Left) Captured Image

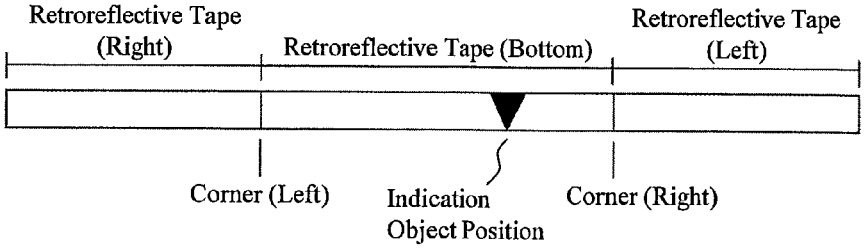


Fig. 5

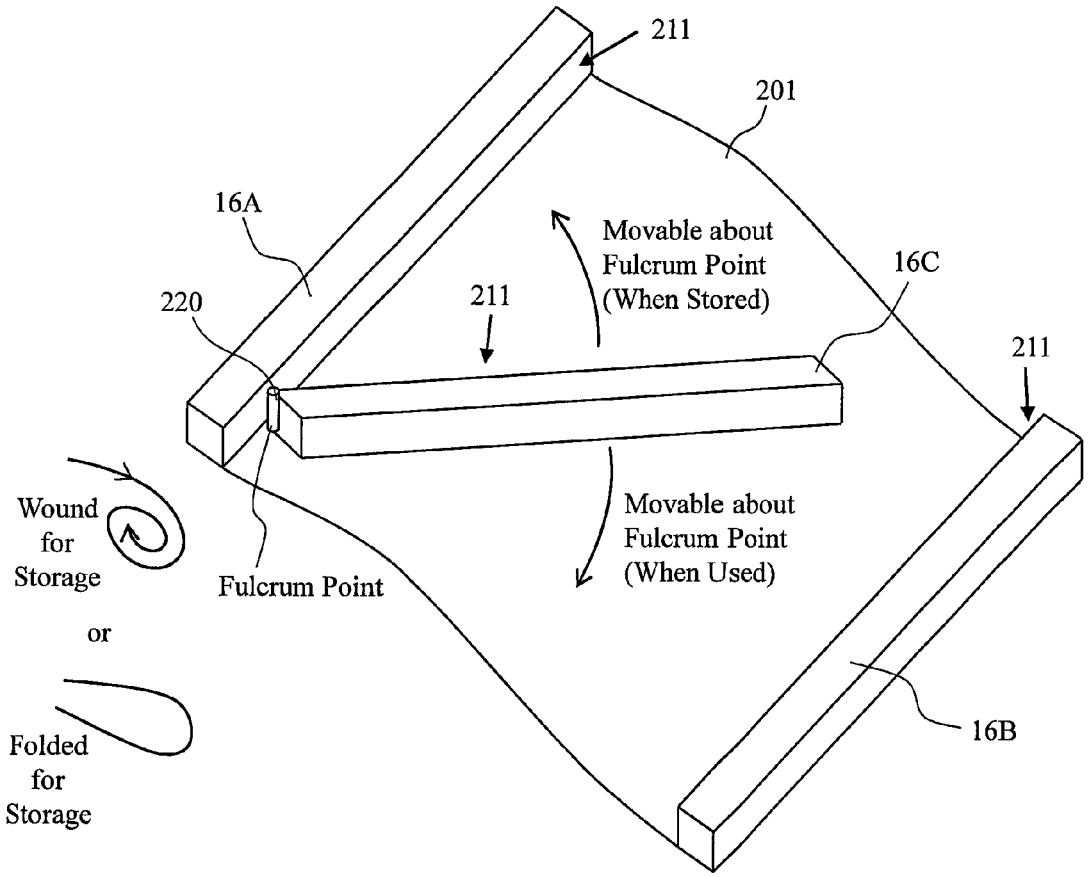

211
201
16A
Movable about
Fulcrum Point
(When Stored)
16C
220
211
211
Wound
for
Storage
Fulcrum Point
Movable about
Fulcrum Point
(When Used)
or
16B
Folded
for
Storage

Fig. 6

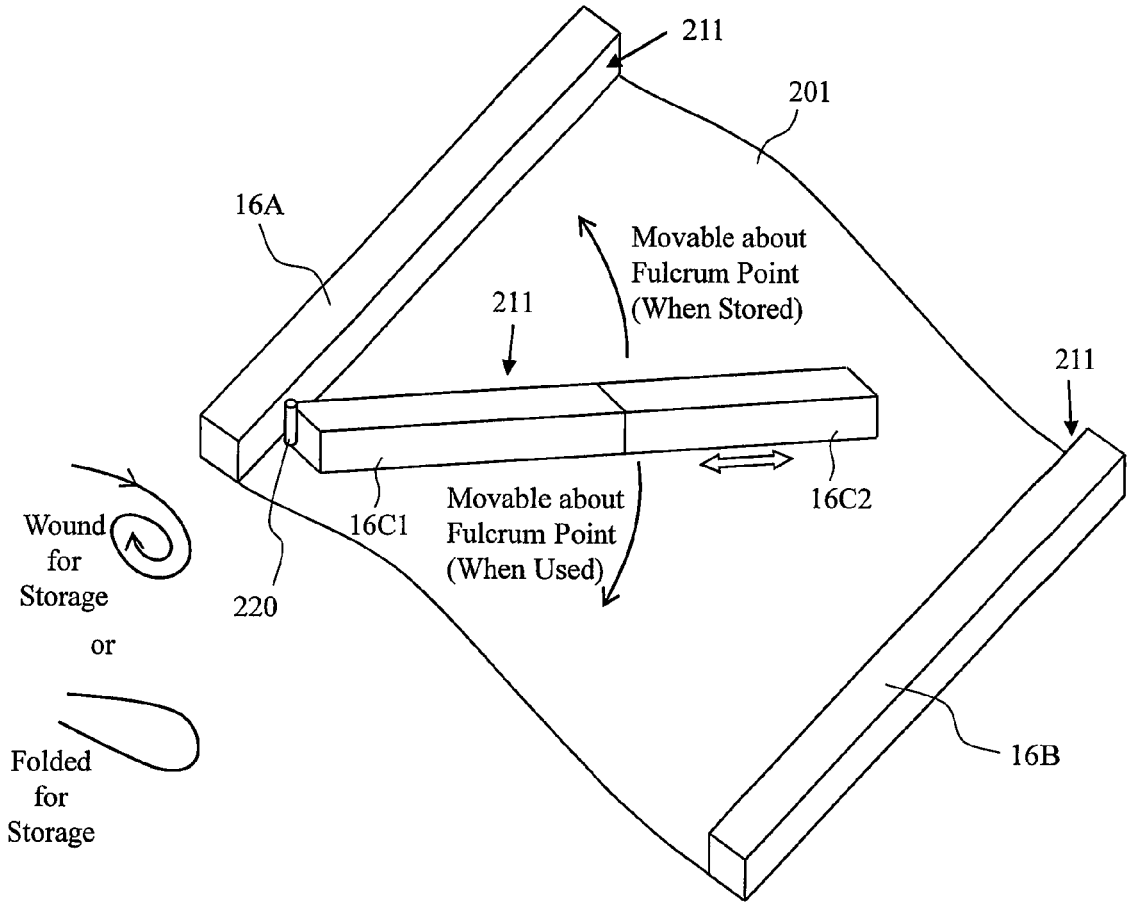

211
201
16A
Movable about
Fulcrum Point
(When Stored)
211
211
16C1
Movable about
Fulcrum Point
(When Used)
16C2
220
Wound
for
Storage
or
Folded
for
Storage
16B

Fig. 7

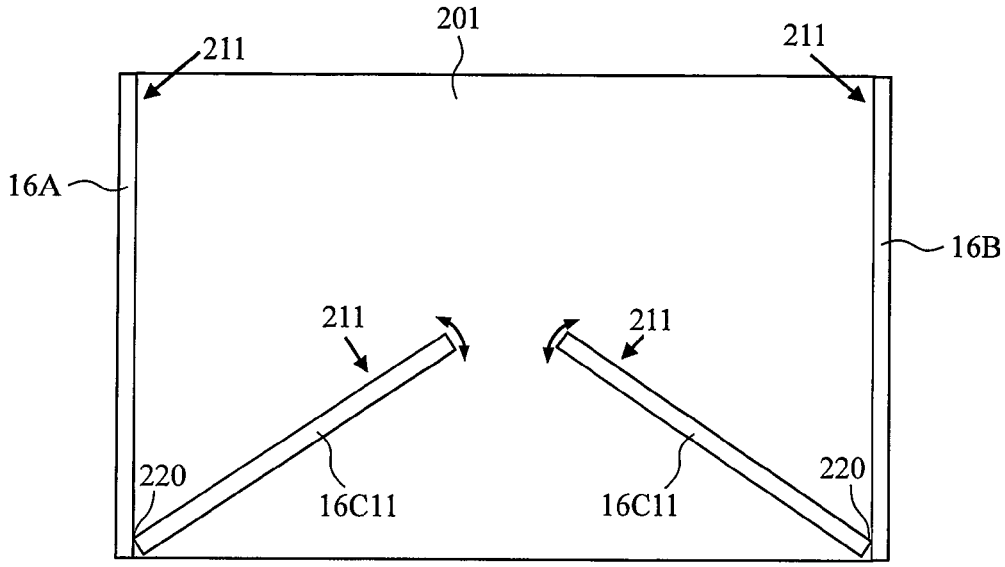

201
211
211
16A
16B
211
211
220
16C11
16C11
220

Fig. 8

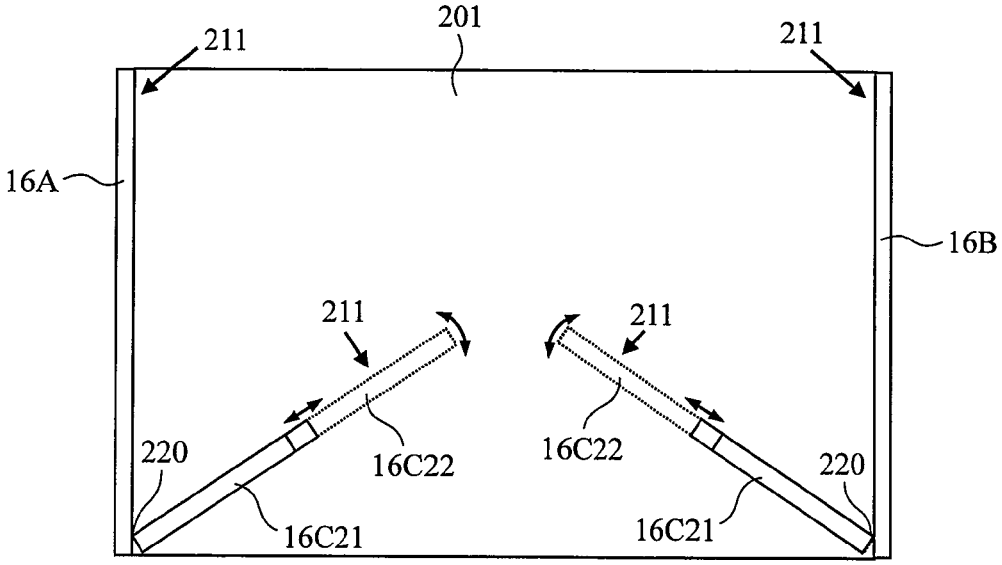

201
211
211
16A
16B
211
211
220
16C22
16C22
220
16C21
16C21

Fig. 9

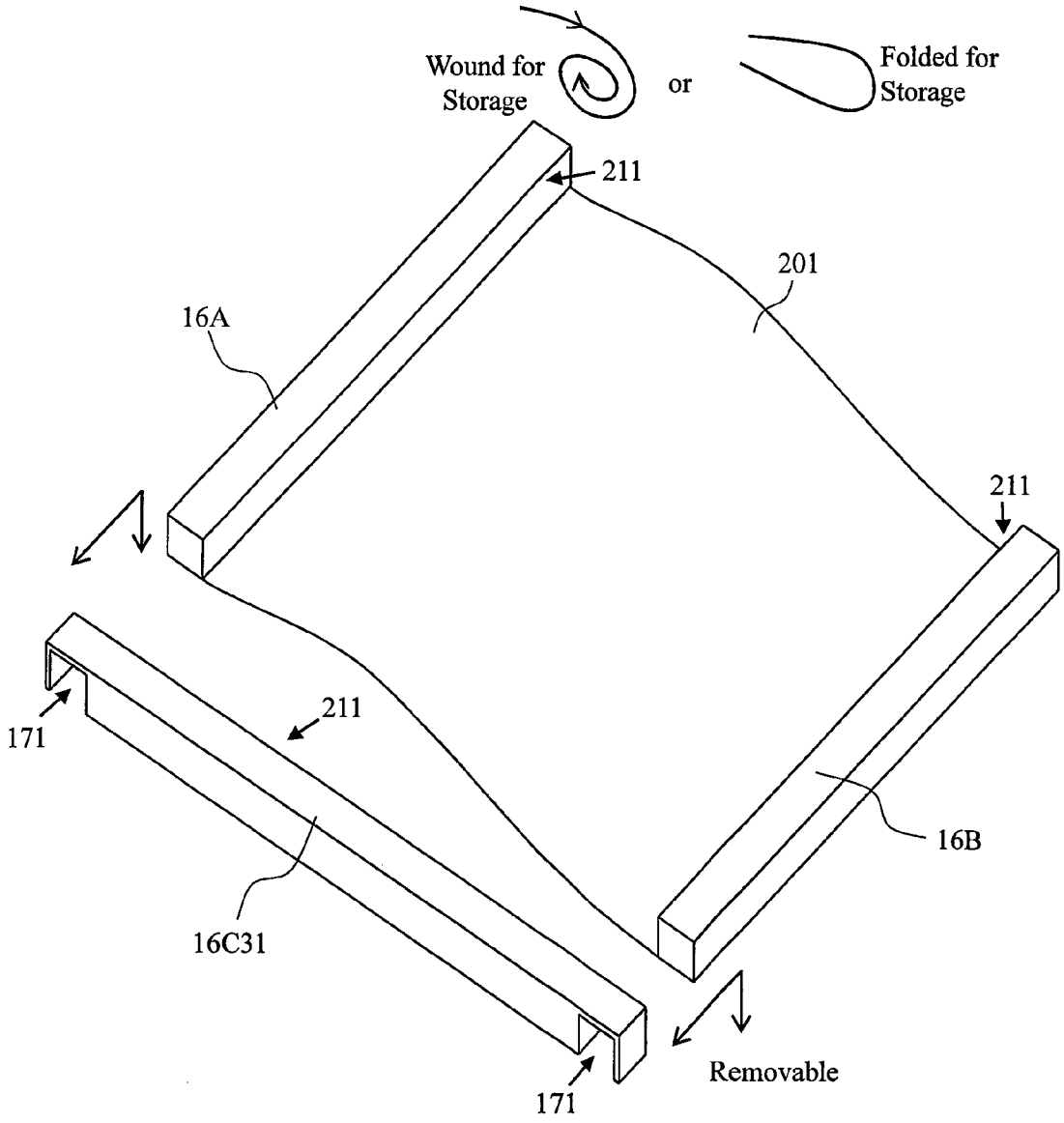

Wound for Storage
or
Folded for Storage
211
201
16A
211
171
211
16B
16C31
Removable
171

Fig. 10

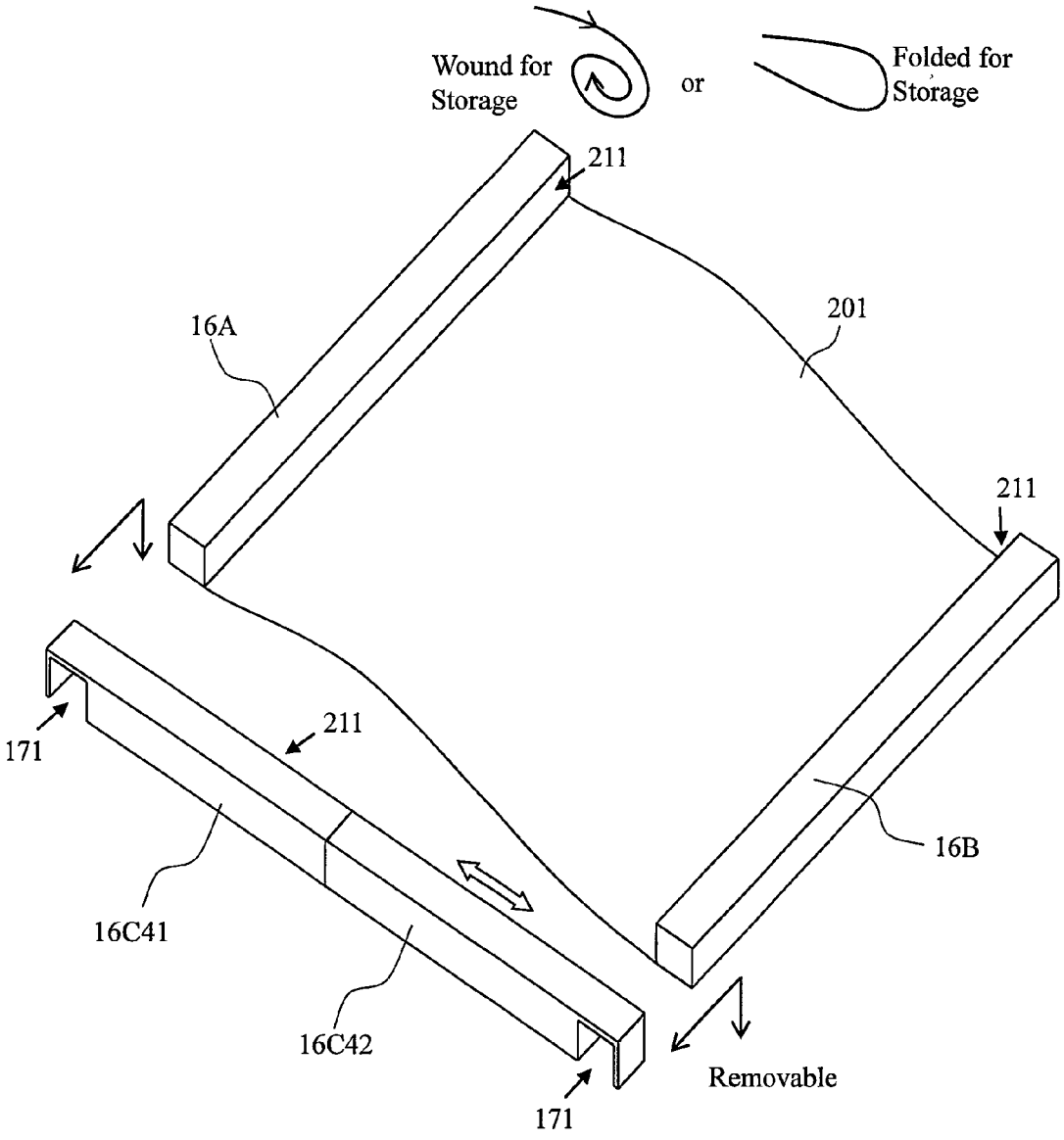

Wound for Storage
or
Folded for Storage
211
16A
201
211
171
211
16B
16C41
16C42
Removable
171

Fig. 11

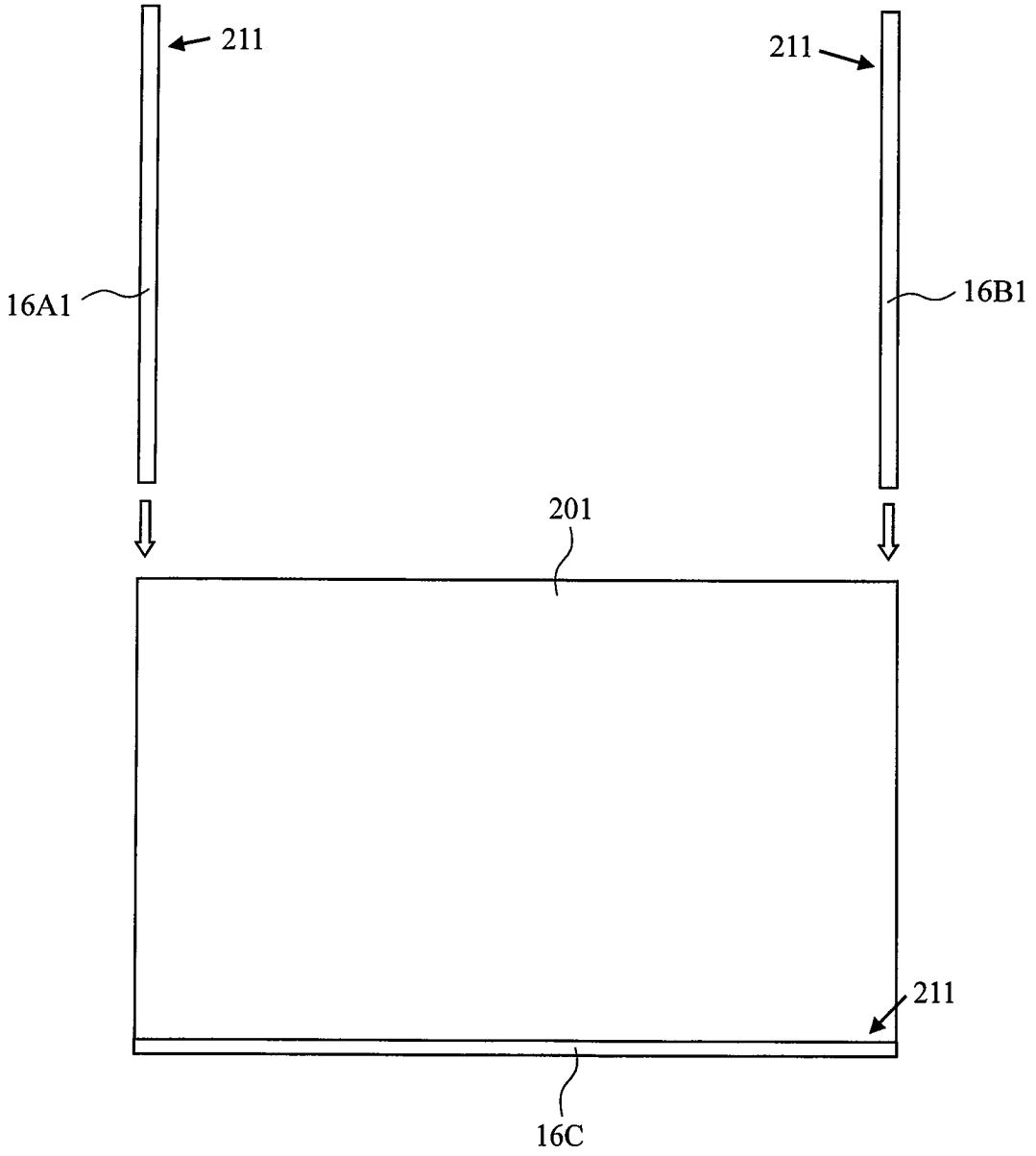


Fig. 12

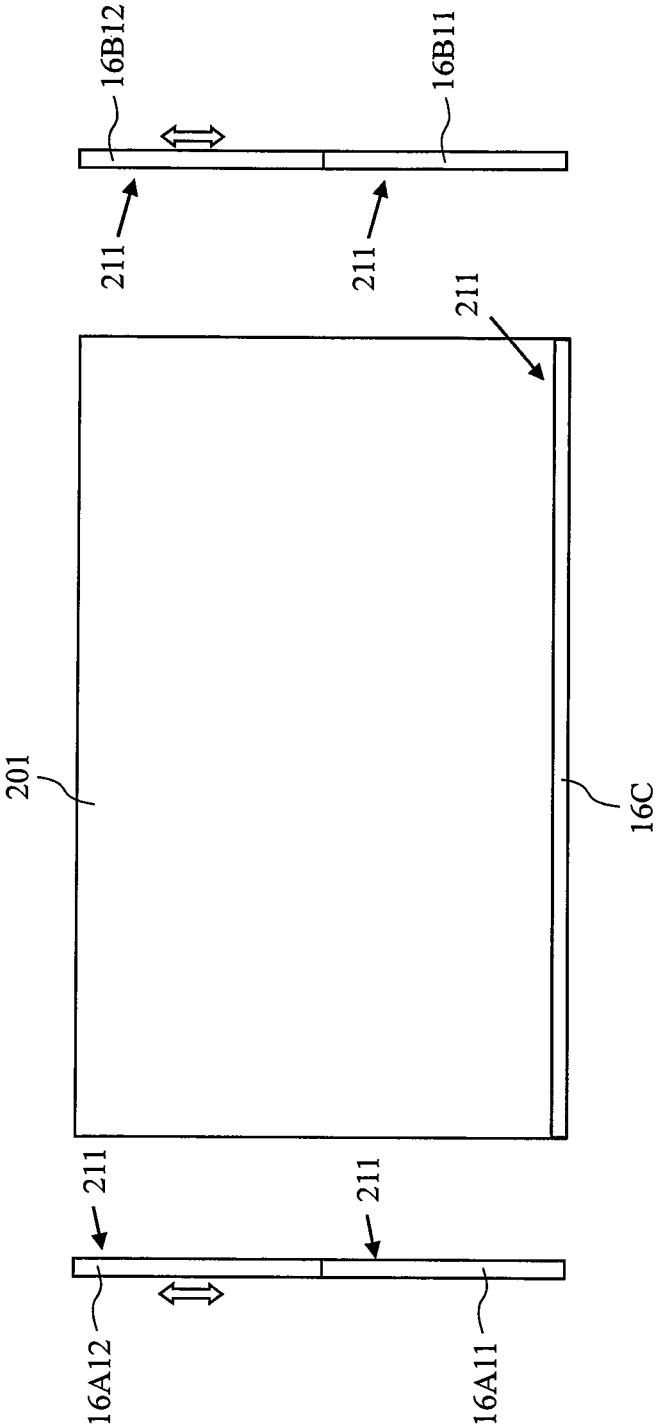


Fig. 13

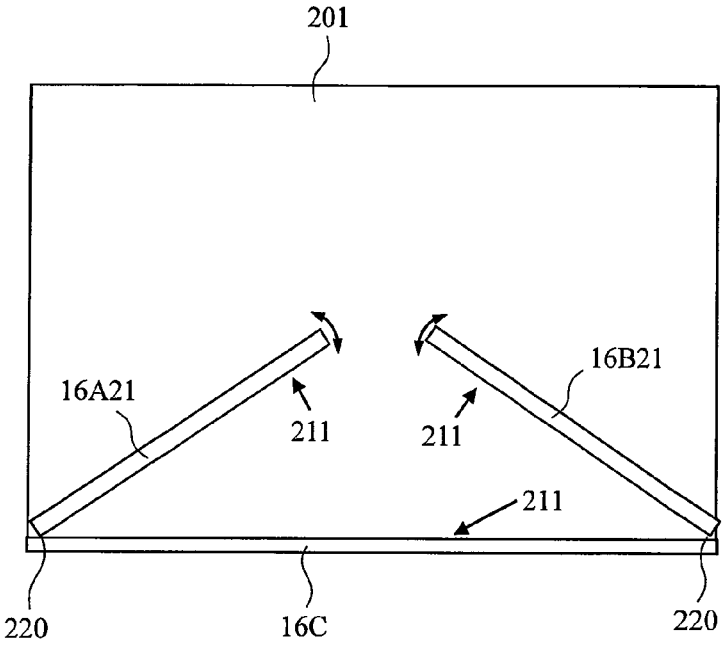

201
16A21
211
211
16B21
211
220
16C
220

Fig. 14

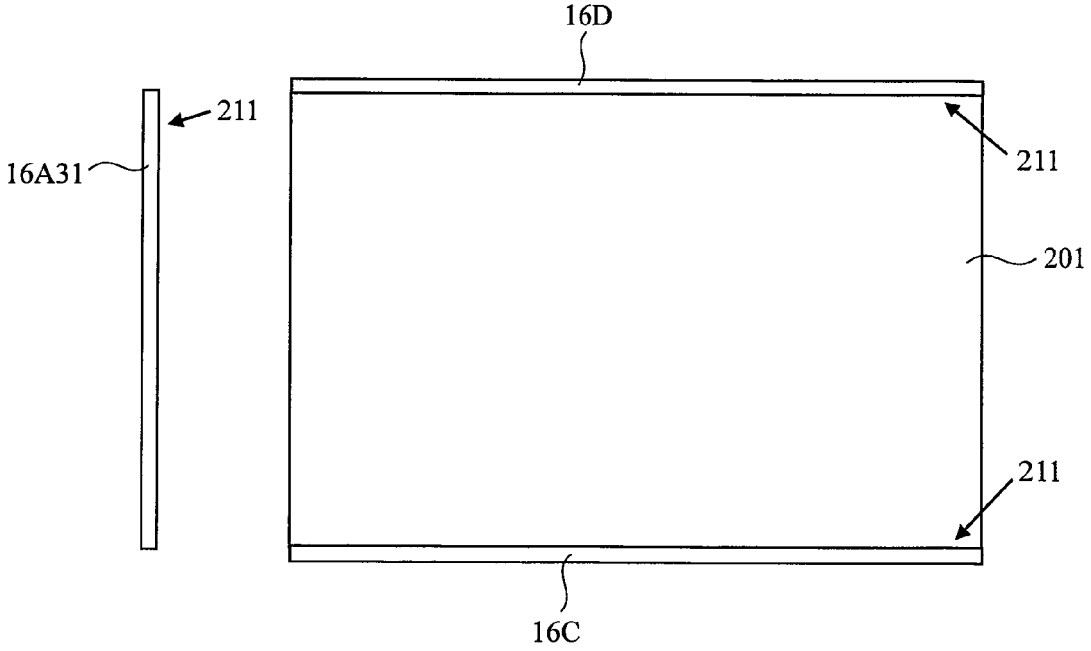

16D
211
16A31
211
201
211
16C

Fig. 15

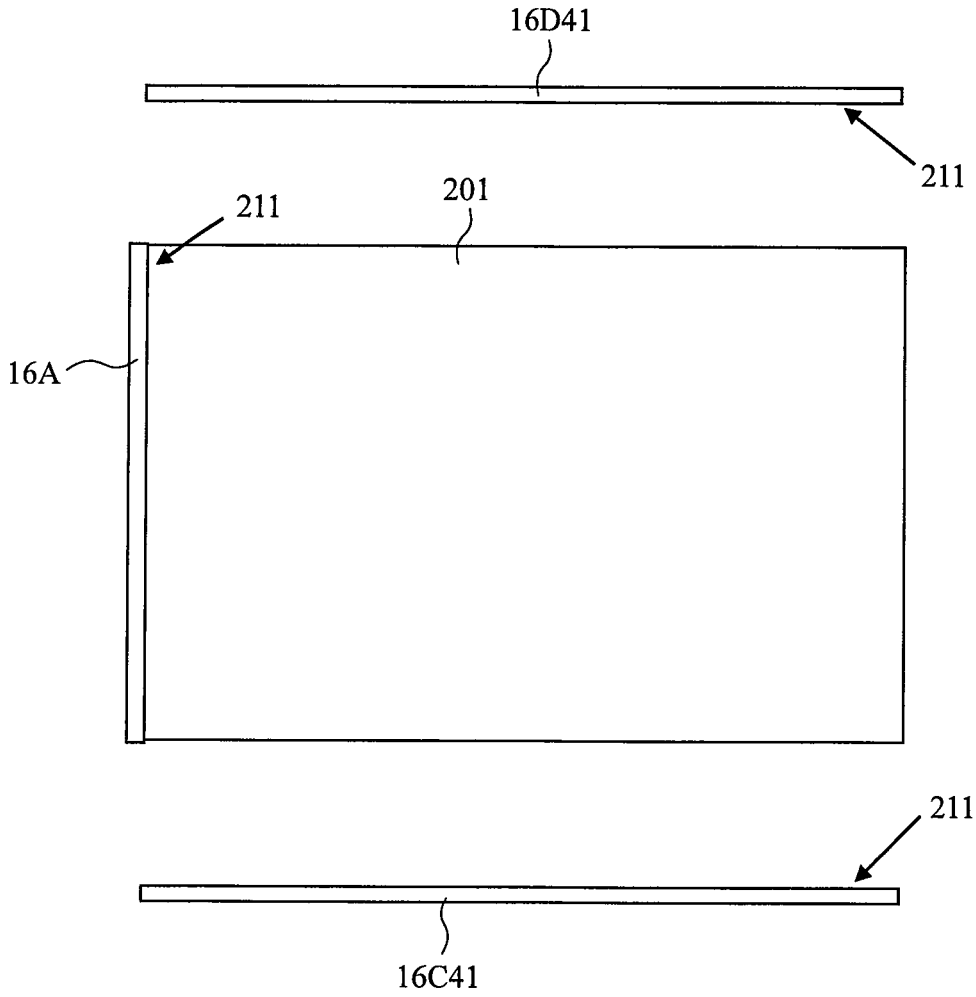
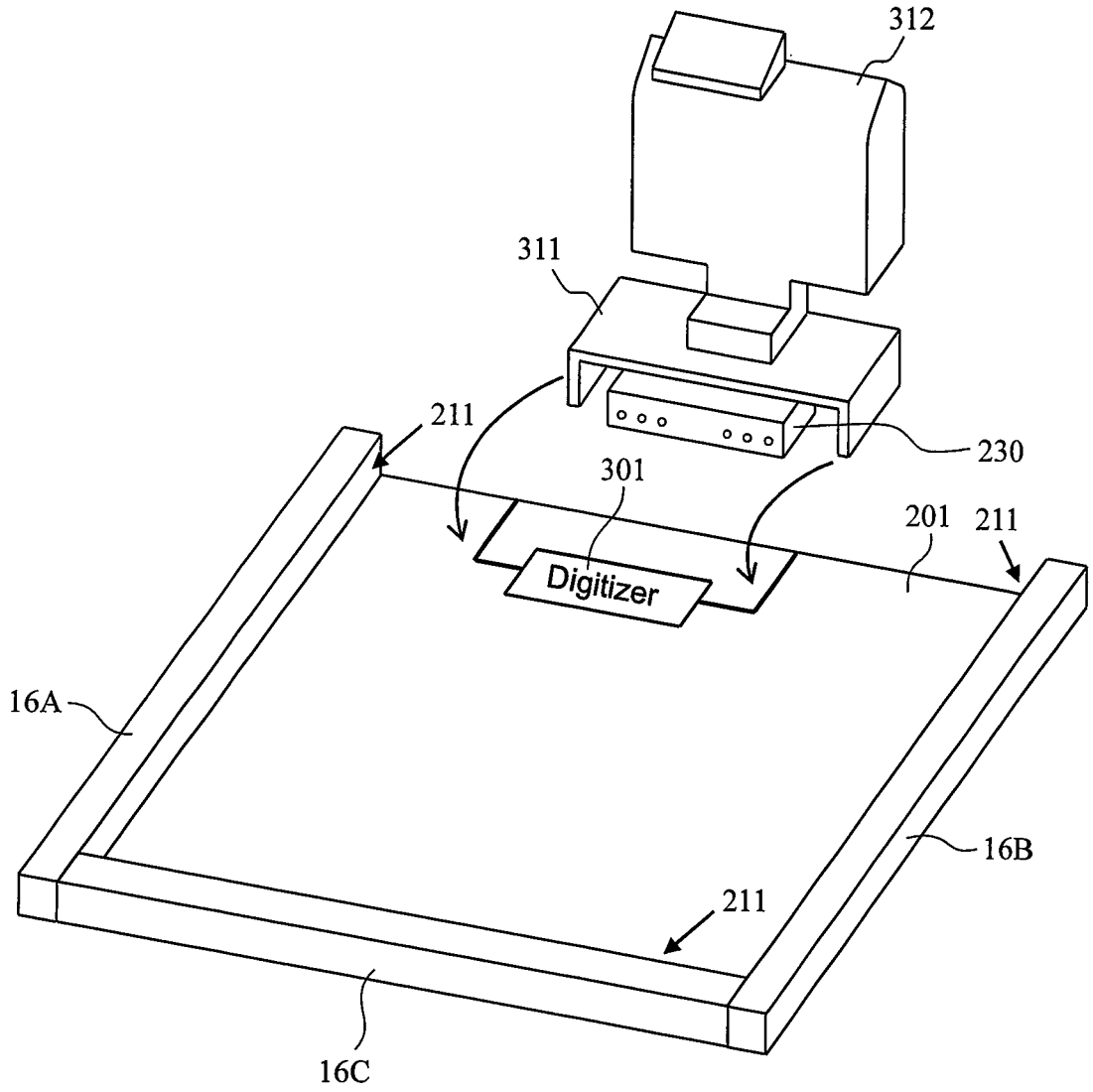


Fig. 16



REFLECTION FRAME-EQUIPPED SHEET

TECHNICAL FIELD

The present invention relates to a reflection frame-equipped sheet that is used as an operation screen and a retroreflective plate of an interactive whiteboard (IWB).

BACKGROUND ART

In recent years, interactive whiteboards for which fingers, electronic pens, and the like are used as input means have come into widespread use. Interactive whiteboards can electronically realize operability that is similar to the operability for when something is written on a blackboard with chalk. An interactive whiteboard includes a coordinate input device and a display device. In addition, the coordinate input device includes a position detection device that detects the position of an operation input by an input means, and an arithmetic unit that processes information on the position.

For the display device, a PDP (Plasma Display Panel), a LCD (Liquid Crystal Display), a projector, or the like is used. For the position detection device, tablet or touch-screen detection devices have started to come into widespread use. As a technology for realizing this, various technologies such as an electromagnetic induction method and an ultrasonic method have been put into practical use.

Besides, among position detection devices, there is also known an optical detection device that captures an image of an area around a display screen (hereinafter also referred to as an "operation input screen") using an image sensor, and detects the position of an input object that has passed transversely across the operation input screen through signal processing on the captured image (see Patent Literature 1 and 2). The optical detection devices have been increasingly used year by year due to their advantages in high response to drawing, high tolerance to external noise such as infrared rays, sunlight, and changes in the temperature, and the like.

The optical position detection device includes image sensors, a control board for processing images acquired by the image sensors, and light sources, and such components are arranged around an operation input screen. For the optical position detection device, two or more image sensors are arranged around the operation input screen. This is in order to detect an input object that has passed transversely across the operation input screen or a shadow thereof from a plurality of visual fields, and detect the input coordinates in accordance with the principle of the triangulation.

A plurality of light sources that emit light rays such as LEDs (Light Emitting Diodes) are arranged around the image sensor. The light sources are mounted substantially in parallel with the operation input screen so that they irradiate a reflective plane with retroreflective ability that is arranged in a manner surrounding the operation input screen. Usually, for a reflective plane with retroreflective ability, a retroreflective tape is used that has minute corner cube retroreflectors and the like uniformly arranged thereon. The retroreflective tape can reflect a light ray back in the direction of a light source independently of the incident angle of the light ray. Hereinafter, a frame that has a retroreflective tape attached thereto along at least one side thereof will be referred to as a retroreflective frame.

That is, an optical position detection device adopts a structure in which a light ray is shone along an optical input screen, and a reflected ray that is reflected back by a retroreflective tape is received (captured) by image sensors. Therefore, when an input object has been brought into proximity with the operation input screen has passed transversely across the operation input screen (i.e., has blocked the light ray), a shadow appears on the captured image. The optical position detection device provides a control board with a position on the shadow detected by the plurality of image sensors, so that the coordinates of the input object that has passed transversely across the operation input screen are calculated.

CITATION LIST

Patent Literature

Patent Literature 1: JP 3931030 B
Patent Literature 2: JP 3986710 B

SUMMARY OF INVENTION

Technical Problem

By the way, a conventional interactive whiteboard is based on the presumption that an operation input screen is put perpendicularly with respect to a floor surface, and is not based on the presumption that it is put on a desk or a floor surface. Further, in applications where a desk or a floor surface is used as an interactive whiteboard, it is considered that an interactive whiteboard that can be easily carried about and stored is demanded.

Solution to Problem

Therefore, the inventor proposes a reflection frame-equipped sheet having a flexible sheet and a retroreflective frame(s) that is/are fixed to one side or two opposite sides of the flexible sheet. In one invention, for a retroreflective frame(s) that is/are fixed to one side or two opposite sides of a flexible sheet, a removable retroreflective frame(s) is/are prepared that is/are attached to another side or the other two sides. In another proposed invention, to a retroreflective frame(s) that is/are fixed to one side or two opposite sides of a flexible sheet, at least one retroreflective frame is attached that can be opened/closed along a surface of the sheet.

Advantageous Effects of Invention

According to the present invention, a flexible sheet can be deformed such that it is wound around a retroreflective frame or folded in two, and thus can be made compact. Other problems, structures, and advantageous effects will become apparent from the following description.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a view showing the schematic structure of an image-sensor-type interactive whiteboard system (conventional);

FIG. **2** is a view showing the detailed structures of image sensors that constitute an image-sensor-type interactive whiteboard system (conventional);

FIG. **3** is a view showing an example of the angles of view of image sensors (conventional);

FIG. **4** is a view showing another example of the angles of view of image sensors (embodiment);

FIG. **5** is a view showing a reflection frame-equipped sheet with a mechanism that allows a retroreflective frame used as the bottom side to be stored on a lateral side;

FIG. **6** is a view showing a reflection frame-equipped sheet in which a retroreflective frame for the bottom side, which can be stored, has a telescopic mechanism;

FIG. **7** is a view showing a reflection frame-equipped sheet with a mechanism that allows a retroreflective frame used as the bottom side to rotate in both the left and right directions;

FIG. **8** is a view showing a reflection frame-equipped sheet in which the retroreflective frame used as the bottom side in FIG. **7** has a telescopic mechanism;

FIG. **9** is a view showing a reflection frame-equipped sheet obtained by fixing a retroreflective frame for the left side and a retroreflective frame for the right side to a sheet, and a retroreflective frame attached to the bottom side thereof;

FIG. **10** is a view illustrating a case where the retroreflective frame used as the bottom side in FIG. **9** has a telescopic mechanism;

FIG. **11** is a view showing a reflection frame-equipped sheet obtained by fixing a retroreflective frame used as the bottom side to a sheet, and retroreflective frames attached to the opposite sides thereof;

FIG. **12** is a view illustrating a case where each of the retroreflective frame used as the left side and the retroreflective frame used as the right side in FIG. **11** has a telescopic mechanism;

FIG. **13** is a view showing a reflection frame-equipped sheet obtained by rotatably attaching retroreflective frames for the left and right sides to a retroreflective frame that is fixed to the bottom side of a sheet;

FIG. **14** is a view showing a reflection frame-equipped sheet obtained by fixing retroreflective frames for the top and bottom sides to a sheet, and a retroreflective frame attached to the left side thereof;

FIG. **15** is a view showing a reflection frame-equipped sheet obtained by fixing a retroreflective frame for the left side to a sheet, and retroreflective frames attached to the top and bottom sides thereof; and

FIG. **16** is a view showing a position detection device for a reflection frame-equipped sheet, and a retroreflective frame-equipped sheet whose seat surface has printed thereon a target installation position of a projector.

DESCRIPTION OF EMBODIMENTS

In the following embodiment, description will be made with the embodiment divided into a plurality of sections or embodiments if necessary. In the following embodiment, when the number of elements and the like (which include the number, numerical value, quantity, range, and the like) are referred to, such a number is not limited to a particular number and may be more than or less than the particular number unless otherwise specified or unless it is obvious that the number is limited to such a particular number in principle.

Further, in the following embodiment, when the shapes, positional relationship, and the like of components and the like are referred to, it is appreciated that such components include those that are substantially similar or close in shape to the components unless otherwise specified or unless it is obvious that the other components are not similar or close in shape to the components of the embodiment.

Hereinafter, the embodiment of the present invention will be specifically described on the basis of the drawings. It should be noted that members having an identical function are denoted by an identical or related reference numeral throughout all the drawings for illustrating the embodiment, and repeated explanation thereof will be omitted. In addition, in the following embodiment, description of identical or similar portions will not be repeated in principle unless it is necessary to do so.

[Conventional Structure of Interactive Whiteboard System]

First, the overall structure of an interactive whiteboard system will be described. Hereinafter, a conventional interactive whiteboard system will be described first to clarify the difference between an interactive whiteboard system in accordance with the embodiment and the conventional interactive whiteboard system.

FIG. **1** shows an overview of a conventional interactive whiteboard system that uses an optical position detection device. An interactive whiteboard system **10** shown in FIG. **1** includes a coordinate input device **11**, an indication object **12**, an arithmetic unit **14**, and a display device **15**.

The coordinate input device **11** includes a position detection device **13** as a signal processing unit and a retroreflective frame **16** as a structural body. Each of the position detection device **13** and the retroreflective frame **16** is attached to a frame body (not shown). In addition, the retroreflective frame **16** is arranged in a manner surrounding the outer edges of the right side, the left side, and the bottom side of an operation input screen. A plane, which is perpendicular to the operation input screen, of the retroreflective frame **16** has a retroreflective tape attached thereto. A surface of the retroreflective tape has minute corner cubes or spherical beads formed thereon.

The position detection device **13** includes a control device **131**, an imaging unit (left) **132**, and an imaging unit (right) **133**. The imaging unit **132** includes an image sensor and a light source. The angle of view of the imaging unit **132** is about 90 degrees, and the imaging unit **132** images the retroreflective tape arranged on the right side and the bottom side of the operation input screen. The angle of view of the other imaging unit (right) **133** is also about 90 degrees, and the imaging unit **133** images the retroreflective tape arranged on the left side and the bottom side of the operation input screen. Note that the light source (not shown) arranged around the image sensor emits an infrared ray in the same range as the imaging range of the corresponding imaging unit **132** or **133**.

As described previously, an infrared ray that is incident on the retroreflective tape is reflected in the direction of a light source regardless of the incident angle of the infrared ray. Therefore, the image sensors of the imaging units **132** and **133** receive the infrared ray reflected by the retroreflective tape. Thus, when an indication object **12**, which has passed transversely across the operation input screen formed through incidence of an infrared ray and a reflection path thereof, is absent, the image sensors of the imaging units **132** and **133** image the surface of the retroreflective tape in the imaging range as it is. Meanwhile, when the indication object **12** such as a finger or a bar has passed transversely across the operation input screen, the object is imaged as a shadow on the imaging screen by the image sensors of the imaging units **132** and **133**. It should be noted that examples of the indication object **12** also include an electronic pen with a wireless communication function.

The control device **131**, upon receipt of the captured images from the imaging units **132** and **133**, determines the position information on the shadow, and computes from the position information the coordinates (X,Y) of the indication object **12** on the operation input screen on the basis of the principle of the triangulation. The computed coordinates (X,Y) are transmitted as coordinate information to the arithmetic unit **14** including a computer and the like. The arithmetic unit **14** generates drawing information (e.g., characters, lines, or figures) on the basis of the received coordinate infor-

mation, and outputs it to the display device **15**. For the display device **15**, a projector may be used as shown in FIG. **1**, or a flat display such as a PDP or a LCD can be used.

FIG. **2** shows the detailed structures of the imaging units **132** and **133**, and FIG. **3** shows an example of an imaged screen acquired by the imaging units **132** and **133**. As shown in FIG. **2**, each of the imaging units **132** and **133** includes an image sensor **134** and a plurality of LEDs **135**. In the case of FIG. **2**, the LEDs **135** are arranged in a plural number so that the irradiation direction thereof has a wide angle. For the image sensor **134**, a CCD sensor, a CMOS sensor, or other image sensors are used, and the image sensor **134** captures an image of the surface of the retroreflective tape through a lens arranged on the light receiving surface thereof. The LEDs **135** emit infrared rays.

The top view of FIG. **3** represents the range of the angle of view of each image sensor **134**. The middle view of FIG. **3** shows an example of the screen imaged by the image sensor **134** arranged on the upper right corner of the operation input screen, and the bottom view of FIG. **3** shows an example of the screen imaged by the image sensor **134** arranged on the upper left corner of the operation input screen. As shown in FIG. **3**, the imaged screen represents a view in which the indication object **12** (in this case, a pen whose tip is conical in shape) is imaged as a shadow.

It should be noted that in order to improve the reading accuracy of the coordinates, it is necessary to cause the optical axis of the image sensor **134** and the optical axes of the LEDs **135** to coincide with or be close to each other. Patent Literature 1 discloses a method of arranging the LEDs **135** around the image sensor **134**, and Patent Literature 2 discloses a method of causing the optical axes of the image sensor **134** and the optical axes of the LEDs **135** to coincide with each other using a half mirror.

[Position Detection Device Used in Embodiment]

FIG. **4** is a view showing the relationship between a position detection device **230** used in the present embodiment and the angle of view for a captured image. Although not shown in FIG. **4**, a housing of the position detection device **230** has a projector integrally mounted thereon.

First, the relationship between the basic structure of the position detection device **230** used in the present embodiment and the angle of view for a captured image will be described. The position detection device **230** includes all of a control device **231**, an imaging unit (left) **232**, and an imaging unit (right) **233** within an independent housing. The function of the control device **231** corresponds to the control device **131** in FIG. **1**. The imaging unit (left) **232** and the imaging unit (right) **233** correspond to the imaging unit (left) **132** and the imaging unit (right) **133** in FIG. **1**, respectively.

The angle of view of each of the imaging unit (left) **232** and the imaging unit (right) **233** is substantially 180 degrees. Each imaging unit includes an image sensor and LEDs. The irradiation angle of the LEDs is also substantially 180 degrees. The structure of each imaging unit is similar to that shown in FIG. **2** except for the imaging angle and the irradiation angle. The angle of view of each imaging unit is not limited to 180 degrees as long as triangulation is possible. For example, the angle of view may be greater than or equal to 160 degrees.

The middle view of FIG. **4** shows a captured image captured by the imaging unit **233**, and the bottom view of FIG. **4** shows a captured image captured by the imaging unit **232**. As described above, as imaging units with a wide angle of view are used, the imaging units **232** and **233** can image the entire retroreflective tape located on the left side, the bottom side, and the right side of the operation input screen.

Thus, the imaging units **232** and **233** can be arranged on the inner side of the left and right ends of the operation input screen. This means that there is no need to provide a special position detection device **230** for each size of the operation input screen. That is, the position detection device **230** in accordance with the present embodiment can be commonly used for operation input screens of any size. Thus, FIG. **4** shows an example in which the position detection unit **230** that is significantly shorter than the horizontal length of the operation input screen is used, and is arranged around the center of the top side of the operation input screen.

USE EXAMPLES

The interactive whiteboard system in accordance with the present embodiment is based on the presumption that it is put on a given horizontal plane such as a desk or a floor. However, when a screen is projected onto a desk, which is a projection plane, from a projector (not shown), if the color of the desk is dark, there is a possibility that the projection plane may be difficult to see. Thus, in the present embodiment, a sheet **201** of a white color or a color close to it is used. It should be noted that the sheet **201** is formed with a flexible material that allows the sheet to be wound or flexed when not in use (stored).

Hereinafter, examples of the retroreflective frame-equipped sheet **201** used in the present embodiment will be described.

Example 1

FIG. **5** shows an exemplary structure of the sheet **201** in accordance with Example 1. The sheet **201** has a rectangular shape such that each of the top and bottom sides is shorter than each of the left and right sides. The sheet **201** in accordance with Example 1 has retroreflective frames **16**A and **16**B fixed to the left and right sides thereof, respectively. Planes, which surround the operation input screen, of the retroreflective frames **16**A and **16**B fixed to the sheet **201** have a retroreflective tape **211** attached thereto.

A retroreflective frame **16**C used as the bottom side is rotatably attached to an area around the lower end of the retroreflective frame **16**A located on the left side via a hinge **220**. In addition, one of the fixtures of the hinge **220** is attached to the surface on which the retroreflective tape **211** is attached, and the other fixture is fixed to one of the end faces of the retroreflective frame **16**C used as the bottom side. With such a structure, the retroreflective frame **16**C used as the bottom side can be opened or closed with respect to the support axis of the hinge **220**, along the surface of the sheet **201**.

When storing the sheet **201**, a user grips the retroreflective frame **16**C used as the bottom side, and rotates it counterclockwise about the support axis of the hinge **220**. Then, the user stops the retroreflective frame **16**C used as the bottom side at a position parallel with the retroreflective frame **16**A used as the left side. At this time, two frames that are the retroreflective frame **16**A for the left side and the retroreflective frame **16**C for the bottom side are parallel with each other. When the sheet **201** is wound around the two retroreflective frames **16**A and **16**C or is folded in two, the interactive whiteboard system can be stored in a compact fashion.

When using the sheet **201**, the user opens the sheet **201** on the horizontal plane, and moves the retroreflective frame **16**C for the bottom side, which has been folded on the retroreflective frame **16**A for the left side, clockwise about the hinge **220**. When the retroreflective frame **16**C for the bottom side is

rotated by 90 degrees from the initial position, an end face, which is the attached side, of the retroreflective frame **16**C used as the bottom side, abuts the surface of the retroreflective frame **16**A for the left side on the hinge **220** side, and thus stops. At this time, another end face (an end face of the movable side) of the end side of the retroreflective frame **16**C used as the bottom side abuts a plane of the retroreflective frame **16**B on the right side to which the retroreflective tape **211** is attached, and thus is fixed.

There may be provided a small gap between the end face of the end side of the retroreflective frame **16**C used as the bottom side and the retroreflective frame **16**B of the right side. In such a case, a position at which the retroreflective frame **16**C used as the bottom side stops is determined by the abutment between the frames on the hinge side **220**. Further, the angle of attachment of the retroreflective frame **16**C used as the bottom side is irrelevant to the use conditions. This is because the retroreflective tape **211** can reflect an irradiation ray in the direction of a light source independently of the incident angle of the irradiation ray. It should be noted that a portion of the retroreflective tape **211** with a length that corresponds to at least the gap portion may lie off the end face of the retroreflective frame **16**C used as the bottom side. When the gap is smaller, it will be more possible to eliminate or minimize the position undetectable area of the indication object **12**.

It should be noted that although the retroreflective frame **16**C that is used as the bottom side and is rotationally moved about the hinge **220** is attached to a portion closer to the lower end of the retroreflective frame **16**A of the left side in FIG. **5**, the position of the attachment is not limited thereto. For example, the retroreflective frame **16**C may be attached to a portion closer to the lower end of the retroreflective frame **16**B of the right side.

Example 2

FIG. **6** shows an exemplary structure of the sheet **201** in accordance with Example 2. The basic structure of the sheet **201** in accordance with the present example is similar to the sheet **201** in Example 1. That is, in the present example, the retroreflective frame **16**C used as the bottom side is also rotationally moved about the hinge **220**.

What is different from Example 1 is that the retroreflective frame **16**C that is rotationally moved about the hinge **220** includes two members **16**C**1** and **16**C**2**, and the member **16**C**2** located on the end side is slidable with respect to the member **16**C**1** on the hinge **220** side. The slide structure may be any structure. For example, the member **16**C**1** is formed in a cylindrical form to allow the member **16**C**2** to be inserted into and removed from the member **16**C**1**. In any case, the member **16**C**2** is, when stored, housed in the member **16**C**1**, and is, when used, pulled from the member **16**C**1**.

This structure is advantageous in that the length of the bottom side can be significantly increased than that of the left side. In the case of Example 1, the maximum length of the frame body when stored is determined by the retroreflective frame **16**C of the bottom side. In contrast, in the case of Example 2, as the length of the retroreflective frame **16** used as the bottom side is variable, the maximum length of the retroreflective frame **16**C when stored can be made less than or equal to the length of the retroreflective frame **16**C when in use. In a preferred embodiment, the maximum length of the retroreflective frame **16**C used as the bottom side when stored can be limited to be less than or equal to the length of the retroreflective frame **16**A for the left side.

It should be noted that the retroreflective frame **16**C used as the bottom side need not include two members, and may include three members. In addition, the retroreflective frame **16** used as the bottom side may not be slidable but be collapsible.

Example 3

FIG. **7** shows an exemplary structure of the sheet **201** in accordance with Example 3. The basic structure of the sheet **201** in accordance with the present example is also similar to the sheet **201** in Example 1. That is, in the present example, the retroreflective frame **16**C used as the bottom side is rotationally moved about the hinge **220**.

What is different from Example 1 is that there are two hinges **220**. That is, the retroreflective frame **16**C used as the bottom side includes two members **16**C**11**, and the respective members **16**C**11** are rotationally attached to the hinge **220** of the retroreflective frame **16**A of the left side and the hinge **220** of the retroreflective frame **16**B of the right side. In the case of this structure, the two members **16**C**11** stop with their ends (movable ends) abutting each other when in use. There may be formed a gap between the ends of the two members **16**C**11**, or an end of the retroreflective tape **211** may protrude beyond the ends of the members **16**C**11** so as to fill the gap.

In this structure, the maximum length of the frame body when stored can also be made less than or equal to the length of the retroreflective frame **16**C of the bottom side when in use. In a preferred embodiment, the maximum length of the frame body when stored can be limited to be less than or equal to the length of the retroreflective frames **16**A and **16**B of the left and right sides.

Example 4

FIG. **8** shows an exemplary structure of the sheet **201** in accordance with Example 4. The basic structure of the sheet **201** in accordance with the present example is similar to the sheet **201** in Example 3. That is, in the present example, the retroreflective frame **16**C used as the bottom side can rotate about the hinge **220** that is attached to each of the left and right retroreflective frames **16**A and **16**B of the sheet **201**.

What is different from Example 3 is that the retroreflective frame **16**C that is rotated about the hinge **220** includes two members **16**C**21** and **16**C**22**, and the member **16**C**22** located on the end side is slidable with respect to the member **16**C**21** on the hinge **220** side. That is, this structure is similar to that of Example 2.

It should be noted that the retroreflective frame **16**C used as the bottom side need not include two members, and may include three members. In addition, the retroreflective frame **16**C used as the bottom side may not be slidable but be collapsible.

Example 5

FIG. **9** shows an exemplary structure of the sheet **201** in accordance with Example 5. As in Example 1, the sheet **201** in accordance with the present example also has retroreflective frames **16** fixed to the left and right sides thereof.

What is different from Example 1 is that in the interactive whiteboard system in the present example, a retroreflective frame **16**C used as the bottom side is prepared as an independent component part from the sheet **201**.

In the present example, attachment structures **171** are formed on opposite ends of a retroreflective frame **16**C**31** used as the bottom side. The attachment structures **171** are

cutouts whose cross sections are rectangular in shape, for example. The size of the cutouts is large enough for the retroreflective frames **16**A and **16**B of the left and right sides to be fitted thereinto. Needless to say, a retroreflective tape **211** is attached to one of the side faces, which corresponds to a long side, of each retroreflective frame.

When storing the sheet **201**, a user takes the retroreflective frame **16C31** used as the bottom side off the sheet **201**. Then, the user winds the sheet **201** around the retroreflective frame **16**A or **16**B of the left or right side, or folds the sheet **201** in two, thereby storing the whiteboard system in a compact fashion. At this time, the retroreflective frame **16C31** used as the bottom side may be overlaid above the left or right retroreflective frame **16**A or **16**B so that the sheet **201** is wound around them.

When using the sheet **201**, the user opens the sheet **201** on the horizontal plane, and attaches the attachment structures **171** of the retroreflective frame **16C31** of bottom side, which is the separate component part, such that the attachment structures **171** are fitted over the retroreflective frame **16**A of the left side and the retroreflective frame **16**B of the right side, respectively.

It should be noted that attachment of the attachment structures **171** to the two, left and right retroreflective frames **16**A and **16**B is not limited to mechanical fitting and may be attachment with a fastening screw mechanism. In addition, as the sheet **201** is put on a horizontal plane such as a desk, the retroreflective frame **16C31** that constitutes the bottom side needs not necessarily be attached to the two, left and right retroreflective frames **16**A and **16**B, and may be merely arranged along the bottom side of the sheet **201**.

Example 6

FIG. **10** shows an exemplary structure of the sheet **201** in accordance with Example 6. The sheet **201** in accordance with the present example also has a retroreflective frame **16C** used as the bottom side, which is formed as a separate component from the sheet **201**, as in Example 5.

What is different from Example 5 is that the retroreflective frame used as the bottom side includes two members **16C41** and **16C42**, and one of the members **16C41** is slidable with respect to the other member **16C42**. The slide structure may be any structure. For example, the member **16C41** is formed in a cylindrical form to allow the member **16C42** to be inserted into and removed from the member **16C41**. In any case, the member **16C42** is, when stored, housed in the member **16C41**, and is, when used, pulled from the member **16C41**.

This structure is advantageous in that the length of the bottom side can be significantly increased than the left side. In the case of Example 5, the maximum length of the frame body when stored is determined by the length of the retroreflective frame **16C** of the bottom side. Meanwhile, in the case of Example 6, as the length of the retroreflective frame **16C** for the bottom side is variable, the maximum length of the frame when stored can be made less than or equal to the length of the retroreflective frame **16C** of the bottom side when in use. In a preferred embodiment, the maximum length of the retroreflective frame **16C** used as the bottom side when stored can be limited to be less than or equal to the length of the retroreflective frame **16**A used as the left side.

It should be noted that the retroreflective frame used as the bottom side need not include two members, and may include three members. In addition, the retroreflective frame used as the bottom side may not be slidable but be collapsible.

Example 7

FIG. **11** shows an exemplary structure of the sheet **201** in accordance with Example 7. In the present example, the retroreflective frame **16C** is fixed only to the bottom side of the sheet **201**, and retroreflective frames **16A1** and **16B1** of the left and right sides are configured as independent component parts.

In this case, each of the retroreflective frame **16A1** for the left side and the retroreflective frame **16B1** for the right side is removably attached to the retroreflective frame **16C** fixed to the bottom side of the sheet **201**. Alternatively, the retroreflective frame **16A1** for the left side and the retroreflective frame **16B1** for the right side are arranged along the left and right sides of the sheet **201**, respectively. As the sheet **201** is put on a horizontal plane of a desk, it need not necessarily be attached to the retroreflective frame **16C** of the bottom side. For example, the retroreflective frames **16A1** and **16B1** may just be arranged along the right and left sides of the sheet **201**.

When storing the sheet **201**, a user takes the retroreflective frame **16A1** for the left side and the retroreflective frame **16B1** for the right side off the sheet **201**. Then, the user winds the sheet **201** around the retroreflective frame **16C** fixed to the bottom side, which is a long side of the sheet **201**, or folds the sheet **201** in two, thereby storing the whiteboard system in a compact fashion. At this time, the left and right retroreflective frames **16A1** and **16B1** may also be overlaid above the retroreflective frame **16C** of the bottom side so that the sheet **201** is wound around them.

When using the sheet **201**, the user opens the sheet **201** on the horizontal plane, and arranges the two, left and right retroreflective frames **16A1** and **16B1**, which are the separate component parts, along the left and right sides of the sheet **201**. It should be noted that the two, left and right retroreflective frames **16A1** and **16B1** may be attached to the retroreflective frame **16C** of the bottom side either through mechanical fitting or using a fastening screw mechanism.

Example 8

FIG. **12** shows an exemplary structure of the sheet **201** in accordance with Example 8. As in Example 7, the sheet **201** in accordance with the present example also has a retroreflective frame **16C** used as the bottom side, which is fixed to the sheet **201**, and retroreflective frames for the left and right sides are configured as the separate component parts.

What is different from Example 7 is that each of the retroreflective frames for the left and right sides includes two members **16A11** and **16A12**, and one of the members **16A12** is slidable with respect to the other member **16A11**. The slide structure may be any structure. For example, the member **16A11** is formed in a cylindrical form to allow the member **16A12** to be inserted into and removed from the member **16C11**. In any case, the member **16C12** is, when stored, housed in the member **16C11**, and is, when used, pulled from the member **16C11**.

It should be noted that the retroreflective frames used for the left and right sides need not include two members, and may include three members. In addition, the retroreflective frame used as the bottom side may not be slidable but be collapsible.

Example 9

FIG. **13** is a view showing an exemplary structure of the sheet **201** in accordance with Example 9. As in Example 7, the

sheet **201** in accordance with the present example also has a retroreflective frame **16**C, which is used as the bottom side, fixed to the sheet **201**.

What is different from Example 7 is that retroreflective frames **16**A**21** and **16**B**21** for the left and right sides are rotatably attached to the opposite ends of the retroreflective frame **16**C for the bottom side by hinges **220**.

When storing the sheet **201**, a user grips the retroreflective frame **16**A**21** for the left side, and rotates it clockwise about the hinge **220**. In addition, the user grips the retroreflective frame **16**B**21** for the right side, and rotates it counterclockwise about the hinge **220**. Then, the user stops the two, left and right retroreflective frames **16**A**21** and **16**B**21** at positions parallel with the bottom side of the sheet **201**. At this time, the two, left and right retroreflective frames **16**A**21** and **16**B**21** are parallel with the retroreflective frame **16**C of the bottom side. When the two retroreflective frames **16**A**21** and **16**B**21** are wound around the sheet **201** or folded in two, the interactive whiteboard system can be stored in a compact fashion.

When using the sheet **201**, the user opens the sheet **201** on the horizontal plane, rotates the retroreflective frame **16**A**21** for the left side counterclockwise, and rotates the retroreflective frame **16**B**21** for the right side clockwise. The rotation of each of retroreflective frames **16**A**21** and **16**B**21** for the left and right sides stops at a position of 90 degrees from the initial position.

In FIG. **13**, each of the retroreflective frames **16**A**21** and **16**B**21** for the left and right sides is configured as a single member, but may also have a slide structure of two members. Needless to say, the slide structure may be any structure. In addition, the retroreflective frames for the left and right sides need not include two members, and may include three members. In addition, the retroreflective frame used as the bottom side may not be slidable but be collapsible.

Example 10

FIG. **14** shows an exemplary structure of the sheet **201** in accordance with Example 9. In Examples 1 to 6 above, cases where a retroreflective frame is fixed to each of the left and right sides of the sheet **201** have been described.

However, as shown in the present example, it is also possible to provide a structure in which retroreflective frames **16**C and **16**D are fixed to the top and bottom sides of the sheet **201**, and a retroreflective frame **16**A**31** as a separate member is attached to or arranged on the left or right side.

Example 11

FIG. **15** shows an exemplary structure of the sheet **201** in accordance with Example 10. In Examples 7 to 8 above, cases where a retroreflective frame is fixed to the bottom side of the sheet **201** have been described.

However, as shown in the present example, it is also possible to provide a structure in which a retroreflective frame **16**A is fixed only to the left side of the sheet **201**, and retroreflective frames **16**C**41** and **16**D**41** as the separate members are attached to or arranged on the top and bottom sides.

Example 12

FIG. **16** shows an exemplary structure of the sheet **201** in accordance with Example 11. In the previous embodiment, cases have been described where a retroreflective frame(s) is/are fixed to one side or opposite two sides of the sheet **201**, and a retroreflective frame(s) as an independent component part(s) is/are attached to another side or the other two sides.

In the present example, the structure of a sheet surface that is common to each example will be described. In the present example, a projection plane of the sheet **201** (specifically, around the middle of the top side of the operation input screen) has printed thereon a mark **301** that indicates the installation position of a projector stand **311** having integrally fixed thereto the position detection device **230** and the projector **312**.

As described above, as the sheet surface has printed thereon the mark **301** indicating the installation position, it is possible to easily position the position detection device **230** integrated with the projector.

REFERENCE SIGNS LIST

10 Interactive whiteboard system
11 Coordinate input device
12 Indication object
13 Position detection device
14 Arithmetic device
15 Display device
16 Retroreflective frame
131 Control device
132 Imaging unit
133 Imaging unit
134 Image sensor
135 LED
201 Sheet
161 Member
162 Member
165 Member
166 Member
167 Member
170 Retroreflective frame
171 Attachment mechanism
172 Member
175 Member
176 Member
180 Retroreflective frame
181 Member
182 Member
191 Retroreflective frame
193 Retroreflective frame
301 Mark
311 Projector stand
312 Projector

The invention claimed is:

1. A reflection frame-equipped sheet comprising:
a flexible sheet on which display images are projected from a projector;
a first retroreflective frame fixed to a first side of the flexible sheet and a second retroreflective frame fixed to a second side of the flexible sheet, the first side and the second side are opposite sides of the flexible sheet;
a third retroreflective frame that is detachably attached to a third side of the flexible sheet,
wherein the third side is the bottom side of the flexible sheet and is between the first side and the second side,
wherein the third retroreflective frame includes a plurality of slideable members, and
wherein the flexible sheet is foldable upon itself for storage.

2. The reflection frame-equipped sheet according to claim **1**, wherein a surface of the sheet has printed thereon a mark indicating installation positions of a position detection device and a projector.

3. The reflection frame-equipped sheet according to claim 1, wherein the flexible sheet is operable for use when a planar surface of the flexible sheet is parallel to a horizontal surface such as a table.

4. The reflection frame-equipped sheet according to claim 1, wherein the flexible sheet is positioned on a horizontal surface when in use.

5. The reflection frame-equipped sheet according to claim 1, wherein

the third retroreflective frame includes at least one notch disposed in a slideable member of the plurality of slideable members,

wherein the at least one notch is configured to engage with one of the first retroreflective frame and the second retroreflective frame.

6. The reflection frame-equipped sheet according to claim 5, wherein

the engagement of the at least one notch with one of the first retroreflective frame and the second retroreflective frame is a mechanical fitting.

7. The reflection frame-equipped sheet according to claim 5, wherein

a rivet is used to secure the engagement of the at least one notch with one of the first retroreflective frame and the second retroreflective frame.

8. The reflection frame-equipped sheet according to claim 6, wherein

the mechanical fitting is secured with a rivet.

* * * * *